

1. Why is it necessary to check the nitrite, nitrate and phosphate ions level during the sewage treatment process?

For treatment process involving nitrogen and/or phosphorus removal, we need to monitor the concentration of nitrate, nitrite and phosphate as they are involved in the reaction mechanisms.

2. In which steps of wastewater treatments do you need to test for the aforementioned ion concentrations?

During the nitrification, denitrification, phosphorus removal processes.

3. What is the standard concentration of the aforementioned ions you are applying in the sewage treatment process?

Please find our present five major STWs results for the aforementioned ions in CS, SS and FE as your information.

Samples	OP (mg/L)	NO2 (mg/L)	Nox (mg/L)
TPCS	2.1 - 7.8	<0.1 - 0.92	<1.0 - 1.7
TPSS	2.5 - 4.3	<0.1 - 0.32	<1.0 - 1.7
TPFE	0.8 - 2.1	<0.1 - 0.45	4.5 - 8.4
STCS	0.9 - 2.6	<0.1 - 1.0	<1.0 - 2.3
STSS	1.7 - 3.1	<0.1 - 0.47	<1.0 - 1.3
STFE	0.7 - 2.1	<0.1 - 0.95	1.9 - 5.9
SKCS	0.69 - 2.7	<0.1 - 1.2	<1.0 - 1.5
SKSS	<0.5 - 3.7	<0.1 - 1.3	<1.0 - 4.1
SKFE	<0.5 - 2.4	<0.1 - 0.35	<1.0 - 2.0
YLCS	<0.5 - 1.7	<0.1 - 0.43	<1.0 - 2.6
YLSS	<0.5 - 2.2	<0.1 - 0.45	<1.0 - 1.4
YLFE	<0.5 - 1.3	<0.1 - 1.3	<1.0 - 25
SWHCS	1.5 - 4.6	<0.1 - 1.3	<1.0 - 8.7
SWHSS	2.6 - 6.0	<0.1 - 1.7	<1.0 - 3.5
SWHFE	<0.5 - 1.9	<0.1 - 0.5	4.7 - 8.4

4. What happens if the concentrations of total phosphorus and NOx are deviated (the condition in which they are too high or too low)? And what happens if the measurement and sewage treatment are failed?

Interview Transcript

We'll take proper and corresponding actions if those concentration deviated from our expectation. We use both online monitors and collect samples back to the laboratory for measurement. Their results agree well with each other and we do not have any complete failure in measurement.

5. What is the technology involved in testing the nitrite, nitrate and phosphate level? What is the machine? Can we know about the mechanism of it? Are the concentrations constantly monitored and the data are constantly reported? Can we see a picture of it?

Flow Injection Analyzer is used to determine the as mentioned ions. The basic principle is the measurands would be reacted with specific reagents to form a color complex. The color complex would be measured at a specific wavelength and its absorbance is directly proportional to the concentration of the determined ions.

6. How fast technician can knows about the concentrations? How important speed is in knowing the concentrations in sewage treatment?

The test results would be obtained in several minutes. It is important to know the concentration of the parameters concern promptly in order to advise the treatment process arrangement and take the necessary actions immediately.

7. Is it an accurate measurement? How accurate it present the data? Can we see the data sheet?

An example for NO_2^- ion, by the as mentioned method, 7 determinations has resulted in < 1% RSD. Please find the results summary as information:

Location	Matrix	No. of Determination	Average of Determination (mg-N/L)	Standard Deviation (mg-N/L)	Relative Standard Deviation (%)
Shatin STW	Crude Sewage	7	0.24	0.002	0.78
Sai Kung STW	Settled Sewage	7	1.3	0.010	0.51
Man Kam To Food Control Office	Final Effluent	7	3.2	0.008	0.24

8. Is it a specific measurement? How specific it is?

The test should be specific if proper sample handling is used and possible interferences are eliminated. For example, the determination of NO_2^- ion is based on the formation of azo dye produced by diazotized sulfanilamide with N-(1-naphthyl)ethylenediamine dihydrochloride. The resulting water-soluble dye has a magenta color which is measured at 520 nm. For determination of orthophosphate ion, it reacts with ammonium molybdate and antimony potassium tartrate under acidic conditions to form a phosphomolybdic acid complex. This complex is then reduced by ascorbic acid to form an intensely colored molybdenum blue complex which absorbs light at 880nm.

9. Any there any limitations of the current testing method?

As mentioned, it should be take note of the interferences that may affect the test results. For example, cupric ion may cause low results in NO_2^- ion by catalyzing decomposition of the diazonium salt. Phosphate free detergents should be used in glassware cleaning to avoid glassware contamination especially for low-level phosphorous determinations, etc.

10. A biosensor is an analytical device which converts a biological response into an electrical signal. The term 'biosensor' is often used to cover sensor devices used in order to determine the concentration of substances and other parameters of biological interest even where they do not utilise a biological system directly. Have you heard of biosensor?

No

11. Are there any local or foreign organisations (including DSD) using biosensor in sewage treatment? If yes, why do they use biosensor?

No

12. Do you think it is feasible in concentration detection in sewage treatment?

No idea, but could be possible

13. Our iGEM project aims to create an NPK microbial biosensor that can detect the concentrations of nitrate, phosphate and potassium ions by inserting certain genes into *E. coli*. We are carrying out an exploratory research to examine different stakeholders perceptions towards using microbial NPK biosensors for waste treatment. Do you have any ideas on what microbial biosensor is?

No

14. Do you think it is feasible in using microbial biosensor in sewage treatment?

No idea, but could be possible

15. What advantages or special features from this genetically-modified biosensor will arouse your interest in using it?

No idea

16. What kind of detections would you prefer other than ion concentration detection by means of biosensor? Heavy metal? pH? Electrochemical values? Different kinds of bacteria or viruses in sewage?

pH, ammonia, organic nitrogen, BOD, COD

17. What potential risks of using the genetically-modified biosensor will make you lose your incentive to use it?

No idea

18. Is using genetically-modified-organism(bacteria)-containing machine to test for concentration in field an appropriate practice in sewage treatment? WHY?

No idea

19. What factor will you take into account when you are deciding whether or not you should use the microbial biosensor? (e.g. cost, effectiveness, safety, duration for the measurement)

No idea

Biotechnological development

20. Would you think genetic engineering is useful in sewage treatment? In which part?

Possible

21. What are the consequences, in ecology and human community, if nitrogen-containing compounds and phosphorus are not properly removed from sewage treatment?

This is the regulations that we need to follow. Any exceedance would affect the water quality.

22. In the last email, you have sent us a table about the concentrations of NO_x and phosphorus in CS, SS and FE.

I believe the concentrations refer to the concentrations of those compounds remain in CS, SS and FE, I am curious why NO_x concentrations increase so much in final effluents, and this increase happens the same in different sewage treatment plants.

This is due the nitrification process for removing nitrogen from the sewage

23. Does it mean CS, SS and FE are measured in BOTH the sewage tank and the lab?

Samples were collected from the tank and analyzed in the laboratory.

24. Could you tell us how the online monitors are done? Are there probes inside the tanks? How can the probes withstand the current? What else can be detected by online monitors? Are there any concentrations detection limits, e.g. the range, the amount?

Please make reference to one of the online monitor supplier for information. Its name is Endress+Hauser, you can obtain information from the web.

25. As for our project, we are trying to genetically modify E. coli, which can possibly detect the concentration of nitrite-nitrate (indistinguishable by the bacteria) and phosphate. And the

Interview Transcript

hypothetical device is immobilising these bacteria in a sensing part of the biosensor, with signal transduction to produce readable data, maybe, on computer. It is hope that we can give immediate results similar to probes; therefore, suggest an in-the-tank detection at various stages of sewage treatment.

As far as I know, sewage should be disinfected during treatment. Is disinfection only applied to tertiary treatment or applied to every step?

The need for disinfection would depend on the corresponding water control zone. Disinfection would be carried out as the last step of treatment.

26. In case, the biosensor in the tank or pipe, which is designed to detect the conc. of N and P in the final effluent, is broken, GM bacteria are released in it. Regardless of its functions, is it a good device? Is it paradoxical to use a device, which, in the end, pollutes the effluent again>

The addition of *E. coli* from the sensor to the effluent will no doubt affect the effluent quality. On the other hand, I guess its quantity might be small and could be handled by the disinfection system. Therefore its impact might not be that significant. Having said that, if that happened after the disinfection step then it would be a disaster.